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CLINICAL RESEARCH ARTICLE

Characteristic of school injuries in Asia: a cross-national, multi-center observational study

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BACKGROUND: To prevent school injuries, thorough epidemiological data is an essential foundation. We aimed to investigate the characteristics of school injuries in Asia and explore risk factors for major trauma.

METHODS: This retrospective study was conducted in the participating centers of the Pan-Asian Trauma Outcome Study from October 2015 to December 2020. Subjects who reported "school" as the site of injury were included. Major trauma was defined as an Injury Severity Score (ISS) value of ≥16.

RESULTS: In total, 1305 injury cases (1.0% of 127,715 events) occurred at schools. Among these, 68.2% were children. Unintentional injuries were the leading cause and intentional injuries comprised 7.5% of the cohort. Major trauma accounted for 7.1% of those with documented ISS values. Multivariable regression revealed associations between major trauma and factors, including age, intention of injury (self-harm), type of injury (traffic injuries, falls), and body part injured (head, thorax, and abdomen). Twenty-two (1.7%) died, with six deaths related to self-harm. Females represented 28.4% of injuries but accounted for 40.9% of all deaths.

CONCLUSIONS: In Asia, injuries at schools affect a significant number of children. Although the incidence of injuries was higher in males, self-inflicted injuries and mortality cases were relatively higher in females.

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IMPACT:

- Epidemiological data and risk factors for major trauma resulting from school injuries in Asia are lacking.
- This study identified significant risk factors for major trauma occurring at schools, including age, intention of injury (self-harm), injury type (traffic injuries, falls), and body part injured (head, thoracic, and abdominal injuries).
- Although the incidence of injuries was higher in males, the incidence of self-harm injuries and mortality rates were higher in females.
- The results of this would make a significant contribution to the development of prevention strategies and relative policies concerning school injuries.

BACKGROUND

School injuries are a public health concern.[1] Schools not only serve as educational places for students, but their grounds also often play multiple roles in communities, such as serving as activity centers, gymnasiums, and auditoriums. As educational activities and other public events, such as large campaigns, sports competitions, and meetings, frequently take place on school grounds, safety assurance, and injury prevention are essential. Furthermore, response systems for emergencies and first-aid treatments for acute injuries for students, staff, and other people are of paramount importance.[2,3]

In the past, research on school injuries has predominantly focused on school-aged children.[4–8] In a healthcare system-based study in the United States of America, 16.5% of injuries in school-aged children visiting emergency departments (EDs) occurred at schools.[4] Moreover, in Korea, 13.3% of injuries in school-aged children transported via emergency medical services occurred at schools.[7] In a school-based study, the incidence of school injury

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was found to be approximately 419 per 1,000 student-years in Lebanon,[6,9] and the incidence of non-fatal school injury was 273 per 1,000 student-years in Taiwan.[5] Notably, most of these studies reported a male predominance in school injuries, ranging from 62% to 77%;[4–7,10] however, whether sex is associated with injury severity or mortality remains unknown. Furthermore, school-aged children are not the only age group at risk for school injuries. The epidemiological characteristics of school injuries among other age groups have not been elucidated.

The characteristics of school injuries are distinct from those of non-school injuries.[4] Understanding these updated characteristics is important for investing resources in prevention programs and first-aid training. In previous studies, unintentional injuries and falls were the most common causes and mechanisms.[6,7,11] Furthermore, contusions, abrasions, and swelling are frequently reported as the predominant injury types.[6,7] However, up-to-date data on these injury characteristics in Asia are lacking.[12] Understanding the characteristics and risk factors of injuries can help shape prevention programs to be more targeted toward certain populations, especially those that are at risk. Furthermore, profiles of the risks for major trauma and mortality cases should be explored for more efficient resource allocation. Therefore, the objective of this study was twofold: to present updated characteristics of school injuries across all age groups and to investigate the risk factors associated with major trauma and mortality within the Asian population.

METHODS

Design and settings

This retrospective study was conducted in the participating centers of the Pan-Asian Trauma Outcome Study (PATOS) from October 1, 2015, to December 31, 2020, with a total of 127,715 registered patients. The PATOS is an Asian clinical research network with a multicenter trauma registry.[13–16] Fourteen medical centers from Asian countries, including Indonesia, Japan, Malaysia, the Philippines, South Korea, Taiwan, Thailand, and Vietnam, participated in the PATOS. Data were collected from coordinators at EDs in various Asian countries that receive trauma patients from emergency medical services (EMS). PATOS expanded the eligibility criteria for communities without EMS system in place, such as Malaysia and Vietnam, encompassing all hospital-based patients transported via non-EMS vehicles.[14] The injuries under consideration may range in severity but must align with the WHO case definition, arising from incidents such as traffic collisions, drowning, poisoning, falls, burns, or acts of violence. The information was gathered through the use of a standardized case report form. Definitions and coding instructions for all variables can be found in a data dictionary, which is provided to all participating sites, accessible at http://lems.re.kr/eng/patos-source-2/. The PATOS registry data included the following: demographic information; injury epidemiology data; prehospital, ED, and hospital care information; injury severity data; and patient outcome data. The data is subsequently collected using an electronic data capture (EDC) system, accessible at http://epatos.org. This system also includes an integrated program to ensure data quality and validation for the information entered. There was monthly national QC report, and all sites respond to the PATOS Data QMC within 2 weeks of receiving data verification requests.

Ethics

Ethical approval was obtained from the coordinating center of the Institutional Review Board of the National Taiwan University Hospital (NTUH-202111004RIND), and all centers involved in the PATOS collaboration had local ethical approval. Written informed consent was waived by the National Taiwan University Hospital Ethics Committee owing to the retrospective design of the study, and the data were anonymized and de-identified to the analyzer.

Patients

Patients for whom "school" was reported as the site of injury were eligible for the study. According to the code book, "school" included kindergartens and schoolyards; however, childcare/daycare centers were not considered within this definition. Additionally, injuries that occurred during the journey to and from school were not within the scope of our research. Patients were grouped according to age at injury as follows: preschool children (0–6 years), school-age children (7–12 years), adolescents (13–18 years), and adults (>18 years).

Variables

Basic demographic data, including age and sex, were collected. The mechanisms of injury (such as traffic injuries, falls, strikes, and cuts), body sites of injury (such as the head, neck, thorax, abdomen, spine, skin, and upper and lower extremities), and types of injury (such as fractures, sprains, cuts, bruises, and organ injuries) were identified for further analysis. Additionally, patient disposition information, including discharge, hospitalization, transfer, or death, was obtained. Furthermore, injury severity was categorized using Injury Severity Score (ISS) values. Among the participating countries considered in final analysis, Korea, Japan, and Malaysia use the AIS 2005 version update 2008 (7-digit codes) while Taiwan uses the AIS 1995 version (5-digits) to compute ISS. All AIS coders and registrars have undergone a standardized training curriculum at their respective local sites. In this categorization, injuries were classified as non-major if the ISS was less than 16 and as major trauma if the ISS was 16 or greater.

Statistical methods

Statistical analyses were performed using SPSS Statistics, version 20 for Windows (IBM, Armonk, NY), and R version 4.0.3. Unless otherwise specified, continuous variables are expressed as medians (interquartile range), and categorical variables are expressed as numbers with percentages. Comparisons of continuous variables were performed using an independent *t* test, and comparisons of categorical variables were performed using the chi-square or Fisher's exact test according to the data conditions. Generalized Estimating Equations (GEE) were employed to assess the influence of variations among countries. We conducted a comparison of variables, including age, causes, and mechanisms, among different sex and injury severity categories. The primary objective was to identify any patterns or differences in the occurrence and characteristics of injuries. We also used multivariable regression analysis to examine the risk factors predicting major trauma. Statistical significance was set at $p < .05$.

Role of the funding source

The funders (Taiwan Ministry of Science and Technology and National Taiwan University Hospital Yun-Lin Branch) had no role in the study design, data collection and analysis, decision to publish, or manuscript preparation.

RESULTS

Demographics of the study population

The demographic and injury characteristics of the cohort are presented in Table 1. The median age of the study population was 15 years (interquartile range, 12–21). Unintentional injuries were the leading cause of school injuries (92.5%), whereas intentional injuries (assault and self-harm) represented 7.5% of the cohort. The most frequently injured body sites were the extremities (lower, 29.0%; upper, 26.1%) and head (26.1%). Fractures (28.3%), cuts (24.1%), and bruises (23.8%) were the dominant types of injuries. In addition, 7.0% of the cases (79 out of 1120) had major trauma, and 22 (1.7%) died. The variances in age, intention, mechanism, and injury severity across these countries were documented in Supplementary Table 1.

A male predominance was observed in the cohort (71.6%) across all age groups and countries [see Supplementary Fig. 1]. Male patients exhibited statistically significant higher incidences of assault (5.3% vs. 1.9%, $p = 0.007$) and strikes/hits by objects (29.8% vs. 21.4%, $p = 0.002$). On the other hand, female patients demonstrated a notable dominance in the adult (36.7% vs. 29.7%, $p = 0.015$) and self-harm injury groups (5.2% vs. 2.3%, $p = 0.006$).

Incidence of school injuries

Of the 127,715 injury events registered in phases I and II of PATOS, 1305 (1.0%) occurred at schools and were thus eligible for review. The annual incidences of school injuries are shown in Fig. 1, and

Table 1. Demographic and injury characteristics of the study population.

Characteristics, *N* (%)	All *N* = 1305	Male *N* = 934 (71.6%)	Female *N* = 371 (28.4%)	*p* value
Age (years), median (IQR)	15 (12–21)	15 (12–20.75)	16 (11–23)	0.260
	N = 1303[a]			
0 ~ 6	101 (7.7)	64 (6.9)	37 (10.0)	0.058
7 ~ 12	263 (20.2)	195 (20.9)	68 (18.3)	0.292
13 ~ 18	526 (40.3)	396 (42.4)	130 (35.0)	0.013*
>18	413 (31.6)	277 (29.7)	136 (36.7)	0.015*
Intention of injury	*N* = 1284[a]			0.001*
Unintentional	1188 (92.5)	850 (92.4)	338 (92.9)	0.775
Self-harm	40 (3.1)	21 (2.3)	19 (5.2)	0.006*
Assault	56 (4.4)	49 (5.3)	7 (1.9)	0.007*
Mechanism of injury	*N* = 1278[a]			0.020*
Traffic Injury	126 (9.9)	84 (9.2)	42 (11.7)	0.175
Fall	584 (45.7)	409 (44.6)	175 (48.6)	0.190
Struck/hit by	351 (27.5)	274 (29.8)	77 (21.4)	0.002*
Others (cutting, poisoning, choking, fire…)	217 (17)	151 (16.4)	66 (18.3)	0.420
ISS	*N* = 1120[a]			0.312
ISS < 16	1041 (92.9)	766 (93.4)	275 (91.7)	
ISS ≧16	79 (7.1)	54 (6.6)	25 (8.3)	
Mortality	22 (1.7)	13 (1.4)	9 (2.4)	0.191

IQR interquartile range, *ISS* injury severity score.
*$p < 0.05$.
[a]Undetermined cases were excluded from subgroup analysis.

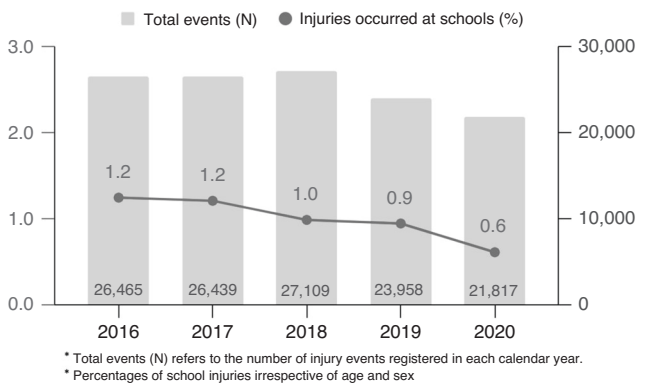

Fig. 1 Proportion of school injury events in the database population. Total events (N) refers to the number of injury events registered in each calender year.

the variation between different countries was illustrated in Supplementary Fig. 2, demonstrating a visually declining trend. These ranged from 0.6 to 1.2 per 100 injury events requiring ED visits ($p = 0.220$). The overall incidence was significantly higher in male patients compared to female patients (1.2% vs. 0.8%, $p < 0.001$).

Children vs. adults

Children comprised most of the cohort (60.5%). The distribution of injury burden categorized by age and sex groups presented in Supplementary Table 2. The highest incidences of injuries occurring at schools were observed among school-age children and adolescents (10.8% and 7.6% of all injury events, respectively). Supplementary Table 3 presented the differences in demographic and injury characteristics between children and adults. In comparison to children, the observed sex differences in adults were relatively smaller (67.1% vs. 73.6%, $p < 0.015$); however, there were significantly more car accidents in adults (19.5% vs. 5.4%, $p < 0.001$). Additionally, there was a higher proportion of severe injuries (12.7% vs. 4.7%, $p < 0.001$) and higher mortality rates among adults (3.6% vs. 0.8%, $p < 0.001$).

Major vs. Non-major trauma

Comparisons of the clinical characteristics of non-major trauma (ISS < 16) and major trauma (ISS ≥ 16) cases are shown in Table 2. ISS data were missing in 185 (14.2%) cases; thus, these cases were excluded from subsequent analyses. The median age was lower in the non-major trauma group (15 vs. 19 years, $p = 0.001$). Adults comprised the majority of the cohort and were significantly more prevalent in the major trauma group compared to the non-major trauma group (53.2% vs. 27.9%, $p < 0.001$). Although the proportion of females was higher in the major trauma group (31.6% vs. 26.4%, $p = 0.312$), the difference did not reach statistical significance. Unintentional injuries were significantly dominant as the cause of injury in the non-major trauma group (93.7% vs. 82.2%, $p < 0.001$). In addition, unintentional injuries were dominant in both the major and non-major trauma groups.

The proportion of cases of self-harm was significantly higher in the major trauma group (12.3% vs. 1.7%, $p < 0.001$). In the major trauma group, the most common body sites of injury were the head (57.0% vs. 24.2%, $p < 0.001$), thorax (32.9% vs. 4.3%, $p < 0.001$), and abdomen (24.1% vs. 6.1%, $p < 001$). Additionally, the proportion of fractures (55.7% vs. 28.0%, $p < 0.001$) and organ injury (54.4% vs. 5.6%, $p < 0.001$) was also significantly higher in the major trauma group.

The mortality rate in the major trauma group was 24.1%. Multivariable regression analysis showed that age >18 years (OR 1.934 (1.094–3.421), $p = 0.023$), self-harm (OR 8.301 (2.774–24.844), $p < 0.001$), traffic injuries (OR 3.450 (1.278–9.314), $p = 0.015$), falls (OR 2.550 (1.179–5.515), $p = 0.017$), head injuries (OR 5.798 (3.092–10.872), $p < 0.001$), thoracic injuries (OR 8.634 (4.052–18.398), $p < 0.001$), and abdominal injuries (OR 2.971 (1.281–6.895), $p = 0.011$) were factors associated with major

Table 2. Comparisons of clinical characteristics of non-major trauma and major trauma cases.

Characteristics, *N* (%)	ISS < 16, *N* = 1,041 (92.9%)	ISS ≧ 16, *N* = 79 (7.1%)	*p* value	Univariable		Multivariable		
				Crude OR	(95% CI)	Adjusted OR	(95% CI)	*p* value
Age (years), median (IQR)	15 (11–20)	19 (15–47)	0.001*					
0 ~ 6	88 (8.5)	1 (1.3)	0.016*	Ref. [b]				
7 ~ 12	223 (21.4)	8 (10.1)	0.017*					
13 ~ 18	439 (42.2)	28 (35.4)	0.240					
>18	290 (27.9)	42 (53.2)	<0.001*	2.936	(1.849–4.661)	1.934	(1.094–3.421)	0.023*
Sex			0.312					
Male	766 (73.6)	54 (68.4)		Ref.				
Female	275 (26.4)	25 (31.6)		1.290	(0.787–2.114)	1.358	(0.755–2.440)	0.307
Intention of injury	*N* = 1040[a]	N = 73[a]	<0.001*					
Unintentional	974 (93.7)	60 (82.2)	<0.001*	Ref.				
Self-harm	18 (1.7)	9 (12.3)	<0.001*	8.117	(3.499–18.830)	8.301	(2.774–24.844)	<0.001*
Assault	48 (4.6)	4 (5.5)	0.771	1.353	(0.472–3.877)	1.755	(0.504–6.113)	0.377
Mechanism of injury	*N* = 1034[a]	*N* = 76[a]	0.002*					
Traffic Injury	85 (8.2)	12 (15.8)		3.694	(1.602–8.517)	3.450	(1.278–9.314)	0.015*
Fall	472 (45.6)	45 (59.2)		2.495	(1.299–4.791)	2.550	(1.179–5.515)	0.017*
Struck/hit by	314 (30.4)	12 (15.8)		Ref.				
Others (cutting, poisoning, choking, fire…)	163 (15.8)	7 (9.2)		1.124	(0.434–2.909)	1.748	(0.576–5.303)	0.324
Site of Injury								
Head	252 (24.2)	45 (57)	<0.001*	4.144	(2.597–6.613)	5.798	(3.092–10.872)	<0.001*
Face	223 (21.4)	15 (19)	0.671	0.860	(0.481–1.538)			
Thorax	45 (4.3)	26 (32.9)	<0.001*	10.858	(6.225–18.938)	8.634	(4.052–18.398)	<0.001*
Abdomen	64 (6.1)	19 (24.1)	<0.001*	4.834	(2.721–8.587)	2.971	(1.281–6.895)	0.011*
Upper Extremity	287 (27.6)	15 (19)	0.114	0.616	(0.345–1.098)			
Lower Extremity	315 (30.3)	24 (30.4)	0.982	1.006	(0.612–1.654)			
Others (spine, skin, neck…)	91 (8.7)	13 (16.5)	0.023*	2.056	(1.093–3.870)	0.617	(0.235–1.622)	0.328
Multiple locations	183 (17.6)	38 (48.1)	<0.001*	4.345	(2.718–6.948)	0.692	(0.332–1.444)	0.326
Types of Injury								
Fracture	291 (28)	44 (55.7)	<0.001*					
Sprain	151 (14.5)	10 (12.7)	0.742					
Cut	268 (25.7)	13 (16.5)	0.079					
Bruise	255 (24.5)	16 (20.3)	0.496					
Concussion	102 (9.8)	11 (13.9)	0.244					
Organ injury	58 (5.6)	43 (54.4)	<0.001*					
Others (burn, …)	58 (5.6)	8 (10.1)	0.097					
Mortality	0 (0)	19 (24.1)	<0.001*					

IQR interquartile range, *ISS* injury severity score.
*$p < 0.05$.
[a]Undetermined cases were excluded from subgroup analysis.
[b]age 0–18.
ISS were missing in 185 (14.2% of total 1305) cases.

trauma. The results of the subgroup analysis by sex are shown in Fig. 2. Self-harm (OR 4.939 (1.080–22.589), $p = 0.039$; OR 11.31 (2.300–55.610), $p = 0.003$) and head injuries (OR 4.771 (2.235–10.186), $p < 0.001$; OR 6.344 (2.149–18.730), $p = 0.001$) exhibited statistical significance in the different sex subgroups. We conducted the GEE model and found no significant impact of country factors on the multivariable model presented in Table 2 and Fig. 2.

Mortalities due to school injuries

Twenty-two patients (1.7% of 1305) died as a result of injuries that occurred at school. Most (68.2%) of these patients were adults (Table 3). Notably, although female patients only comprised 28.4% of the total cohort, 40.9% of the mortality cases were female. However, this difference was not statistically significant ($p = 0.191$).

While only 3.1% of all events were caused by self-harm, this mechanism accounted for 27.3% of the mortality cases ($p < 0.001$),

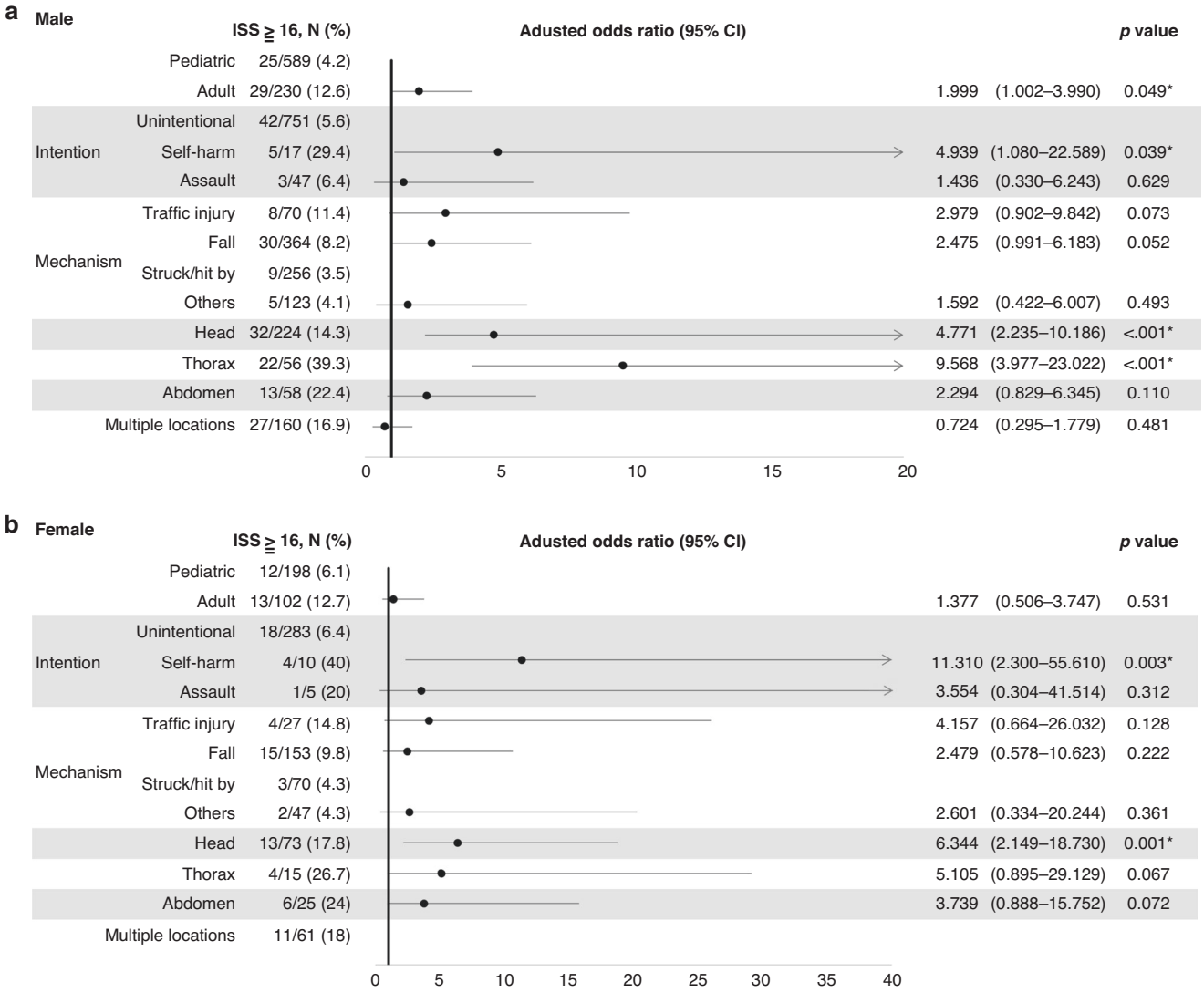

Fig. 2 Multivariable regression analysis of adjusted risk factors for major trauma (ISS ≥ 16). a In male patients. **b** In female patients.

and the mortality rate of self-harm injuries in our cohort ($N = 40$) was 15.0% [see Supplementary Table 4]. Among the mortality cases, falls (63.6%) and traffic injuries (22.7%) were the most common mechanisms of injury. Furthermore, 10 patients (45.5%) required cardiopulmonary resuscitation before arriving at the ED, and 15 (68.2%) required cardiopulmonary resuscitation in the ED. Ultimately, 13 (59.1%) of the mortality cases died in the ED.

DISCUSSION

This study has three important findings. First, in Asia, injuries at schools accounted for 1.0% of all injuries among patients attending the ED and up to 10.8% among children. Notably, 68.2% of school injuries were seen among children under the age of 18 years. Second, although a male predominance was noted in all age groups, female patients accounted for a significant proportion of the mortality and self-harm groups. Lastly, numerous factors were found to be associated with major trauma, and self-harm was a significant factor in both male and female patients.

Schools play a crucial role as settings where injuries can occur, especially for vulnerable children. To the best of our knowledge, injury events at schools have not been reported in international and multicenter studies. To date, this study is the most comprehensive and largest epidemiologic report of school injuries among all age groups in Asia. In our cohort, 1.0% of injuries in patients attending the ED occurred at school, with the highest incidence in school-age children (10.8%) and adolescents (7.6%). Furthermore, while schools accounted for only a small proportion of injuries among adults, school injuries constituted 31.6% of the cohort and more than half of the major traumatic events. To the best of our knowledge, there were no previous report regarding the overall incidence of school injuries among adults. A study conducted in Germany reported an incidence range of 1.07–1.79 per thousand male employees in higher education institutions.[17] Thus, relevant prevention and management programs should not overlook the fact that adults can also be injured at schools.

In previous studies, school injuries represented 13.3–18.0% of all injuries in school-aged children requiring medical care.[4,7,18] However, the lower incidence observed in our study could be attributed to the different study designs employed. Additionally, cultural differences may play a role in explaining the lower incidence of school injuries in Asia. For instance, in the United States, nearly 11.0% of school injuries were classified as violent, and half of these injuries were in the 10- to 14-year-old age group.[4] In contrast, school injuries related to assaults accounted

Table 3. Demographics and characteristics of mortality cases ($N = 22$, 1.7% of 1305 cases).

Characteristics	*N* (%)
Age (years), median (IQR)	22.5 (16.5–46)
0 ~ 6	0 (0)
7 ~ 12	2 (9.1)
13 ~ 18	5 (22.7)
>18	15 (68.2)
Male	13 (59.1)
Female	9 (40.9)
Intention	
Unintentional	10 (45.5)
Self-harm	6 (27.3)
Assault	0 (0)
Undetermined	6 (27.3)
Mechanism	
Traffic Injury	5 (22.7)
Fall	14 (63.6)
Struck/hit by	1 (4.5)
Hanging	1 (4.5)
Undetermined	1 (4.5)
Cardiac arrest at triage	10 (45.5)
CPR at ED	15 (68.2)
Operation	9 (40.9)
ED death	13 (59.1)

CPR cardiopulmonary resuscitation, *ED* emergency department, *IQR* interquartile range.

for only 4.3% of the events in our study. It is noteworthy that firearm-related injuries are the leading cause of death among children and adolescents in the United States.[19] However, the enrolled countries in our study have implemented strict gun control policies, potentially contributing to the lower incidence of firearm-related injuries. In 2019, the age-standardized incidence rate of firearm violence ranged from 1.01 in Southeast Asia to 10.64 in Eastern Europe.[20]

In line with previous research, a male predominance was observed in our study.[4,5,12,21] Boys are injured more frequently regardless of the severity or age group, as boys are hypothesized to engage in more dangerous behaviors that are likely to cause injury, such as hanging or climbing high.[7] One of the highlights of the current study was the observation that female patients comprised a small proportion of the non-major trauma group but a higher proportion of the major trauma and mortality groups.

While it is generally observed that male patients have a higher likelihood of dying by suicide, it is important to note that the epidemiology of suicide and its risk factors vary worldwide.[22] Notably, the female age-standardized suicide rate in the Southeast Asia region is higher than the global average, and the suicide rates among young female patients are higher than those in the general population in some countries.[22] Therefore, the observation that a higher proportion of female patients comprised the majority of the major trauma and mortality cases in the present study underscores the importance of school-based awareness and interventions. Urgent priority should be given to psychological and environmental safety measures directed toward suicide prevention.[22,23]

Regardless of the location, traumatic injuries are the leading cause of death in children.[19,24,25] A strength of the current study is the relatively large number of cases in the major trauma group. From a school-based perspective, approximately 0.2% of the injuries at school are classified as severe.[6] From an ED-based perspective, 15.5% of the children who are admitted to the ED due to unintentional injuries at school present with moderate or severe injuries.[26] However, in a previous report, injury severity was not defined by standardized ISS values, and no mortality was noted in the report's study group.[26] To the best of our knowledge, there have been no reports regarding the risk factors that predict major trauma in school injuries, as defined by standardized ISS values. In light of these findings, educational programs to prevent injuries to the head, thorax, and abdomen should be implemented. For example, educational courses, such as lectures or workshops, could be designed to enhance the understanding of common causes of injury and promote safe behaviors among students and school staff.

In our cohort, unintentional injuries accounted for more than 90% of the total injury events, implying that the implemented preventive management measures were inadequate. Schools, being public and promising sites, play a crucial role in injury prevention through the implementation of structural strategies[27,28] For example, considering that falls and traffic injuries are two of the most common mechanisms of injury, school-based prevention programs should prioritize environmental screening for high-risk locations for such incidents. In these locations, increasing illumination and placement of warning signs should be taken into consideration. Moreover, although self-harm injuries accounted for only 3.1% of all cases but had a relatively high mortality (15.0%) in our cohort, potentially causing significant psychological impact on the campus community.[26] Therefore, we recommend implementing basic management approaches, such as creating barriers at targeted jump sites, to reduce the availability of means for self-harm and thus decrease suicide rates.[29]

Limitations

This study has certain limitations. First, the PATOS database collected data from the EDs of medical centers in urban cities. This may have resulted in some limitations in the generalizability of our findings. However, as our study focused on injuries requiring ED visits, which tend to be more severe than those treated in other venues, the results still provide valuable information for public health policymakers to establish priorities and develop strategies for the prevention of moderate and severe school injuries. Second, there were variations between countries regarding the differences in age, intention, mechanism, and injury severity. Furthermore, the number of patients in each country was not evenly distributed. Each country had its own unique issues that require attention. However, country factors did not impact the multivariable model, and our research primarily focused on presenting the overall trends in Asia. Therefore, the cohort still provided valuable insights for comparison with Western countries. Third, owing to the retrospective registry study design, information regarding the circumstances of injuries was limited. The exact location of where the injury occurred at the school, activities being performed when the injury occurred, role of the patients as pedestrian, vehicle occupants or cyclists, exact height of the fall, degree of supervision of the patient when the injury occurred, and presence or absence of a formal injury prevention program could not be retrieved. Further comprehensive studies are required to examine targeted populations, including individuals of various ages and sexes as well as those with a higher self-harm probability. Fourth, a small proportion of patients did not have ISS values in their data. As 14.2% of the total cases (185 cases) had missing data, this might have impacted the subgroup analyses. However, our sample size was relatively large compared to previous reports.

CONCLUSIONS

In Asia, 68.2% of school injuries were observed among children. While the overall incidence was higher in male patients, relatively higher proportions of female patients were observed in the self-harm and mortality groups. Additionally, the demographic characteristics of major trauma cases varied in terms of injury causes, mechanisms, and body sites of injury. It is important to focus on implementation aspects such as promoting multisectoral collaboration and prioritizing school injuries on national health agendas. This study offers crucial information for the development of policies aimed at preventing injuries in school settings.

DATA AVAILABILITY

The datasets analyzed during the current study are not publicly available due the regulations of PATOS organizations but are available from the corresponding author on reasonable request approved by the PATOS EXCO meeting mainly composed of data-contributing principal investigators. The contact of the PATOS coordination center is listed below. Ms. Suhee Agnes KIM, MPH. Laboratory of Emergency Medical Services, Biomedical Research Institute. Seoul National University Hospital, Seoul, South Korea. Tel: +2 2072 4683; Mobile: +82 10 8572 7715; http://lems.re.kr/ E-mail: suheekimsnuh@gmail.com.

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S.-H.C.: Writing—Original Draft, Formal analysis, Visualization. M.-C.L.: Writing—Review & Editing. P.-.-Y.W.: Writing—Review & Editing. W-.-C.T.: Conceptualization, Writing—Original Draft, Formal analysis, Writing—Review & Editing. W.-C.C.: Conceptualization, Writing—Review & Editing, Supervision. M-.H.-M.M.: Writing—Review & Editing, Supervision. S-.D.S.: Methodology, Validation, Resources, Project administration. J.-T.S.: Methodology, Validation, Resources, Project administration. S.F.J.: Methodology, Validation, Resources, Project administration. H.T.: Methodology, Validation, Resources, Project administration. D.N.S.: Methodology, Validation, Resources, Project administration. K.J.H.: Methodology, Validation, Resources, Project administration.

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COMPETING INTERESTS

The authors declare no competing interests.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

All methods were carried out in accordance with relevant guidelines and regulations. This research did not involve human embryos, gametes, and stem cells. Ethical approval was obtained from the coordinating center of the Institutional Review Board

of the National Taiwan University Hospital (NTUH-202111004RIND), and all centers involved in the PATOS collaboration had local ethical approval. Written inform consent was waived by National Taiwan University Hospital Ethic committee because the designs of retrospective, and data were anonymous and de-identified to the analyzer.

ADDITIONAL INFORMATION

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